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Indicating availability status of services provided by a  
mobile communication network

#### FIELD OF THE INVENTION

The present invention relates to methods and arrangements in  
5 a mobile 3<sup>rd</sup> generation communication system and user  
equipments intended for usage in such systems. It relates in  
particular to situations when certain services, e.g. related  
to emergency calls, in the UTRAN are not available while the  
user equipment could perform this service also over a backup  
10 network, e.g. a GSM-network, which it can access.

#### SUMMARY OF THE INVENTION

The present invention relates to the radio network part  
(UTRAN) of a 3<sup>rd</sup> generation communication system, e.g. a  
15 WCDMA-system, to which the following will refer to as an  
example, and addresses in particular problems that may arise  
when certain services, which the network is supposed to  
offer, are unavailable, e.g. due to faults in one of the  
units or links of said communication system or due to  
20 temporary congestions in said communication system.

Present 3<sup>rd</sup> generation communication systems, as standardised  
by the 3<sup>rd</sup> Generation Partnership Project (3GPP), do not  
fully support to use another communication system, e.g. a  
GSM-system, as a backup system for services that are  
25 temporarily unavailable. Vice versa, there is presently no  
full support to use the UTRAN as a backup system, e.g. of a  
GSM-system, which is only used for certain services.  
Instead, a user equipment must stay in the communication  
system, which it presently is associated to, although a

required service is presently not available or the user equipment is forced to move entirely to the backup communication system, although certain services that are needed by the user equipment would still be available in the  
5 disturbed system.

It is therefore an object of the present invention to increase the availability of services to user equipments even when the UTRAN temporarily does not work properly with regard to a certain service. Within the scope of the present  
10 invention, services relate to such services that can be performed typically in the one network, e.g. the UTRAN, but also in a backup communication network, e.g. the GSM-system. One important example of such services relates, e.g., to emergency calls. However, the invention is notwithstanding  
15 also applicable for other kinds of services.

It is a further object of the present invention to achieve a prioritisation with respect to certain services between a first and a second communication network, i.e. certain services are preferably performed in one of the  
20 communication networks although the user equipment remains associated with one network.

This and other objects of the present invention are achieved by a communication system and a user equipment that are capable of providing the following features:

25 1) An appropriate network unit 12 within the UTRAN 10, e.g. the Radio Network Controller serving said user equipment, comprises means to inform user equipments 14 that are served by said system 10 about UTRAN services that are not available and, optionally, additional information that may  
30 indicate, e.g., a reason for said unavailability or an estimated time interval within which a service is

unavailable. Possible reasons for such service unavailability can be, e.g., a network fault or a traffic congestion. Alternatively, the network 10 can instead indicate the still available alternatives in case of a network fault. More generally, the UTRAN 10 comprises an appropriate status information with regard to the availability of at least a certain range of its services.

2) The network 10 is capable to re-direct a user equipment 14 to a backup network 11, e.g. a GSM-network, in cases where a needed service in the UTRAN 10 is not available. It is thus possible for the user equipment to use available services in UTRAN while the network or user equipment can arrange that temporarily unavailable services are instead provided by the backup network 11.

3) A user equipment 14 comprising means to indicate to the network the priority of new requested services. The priority information can be used by the network, e.g., when the user equipment requests a temporarily unavailable service while already using another network service. Then, the re-direction is only performed if the new service has a higher priority.

It is a first advantage of the present invention that the service availability is increased although, e.g., a fault or temporary congestion limits or prevents a user equipment from using this service in the network, which it is associated to.

It is thus a further advantage of the present invention that the overall availability of services can be increased due to the possibility to obtain certain services from the one or other network, which can be used advantageously in

congestion situations and, thus, can serve for load control purposes.

It is still another advantage of the present invention that the time within which a user equipment is not pageable after  
5 a RRC Connection Release message and data interrupt times are significantly reduced.

Other objects, advantages and novel features of the invention will become apparent from the following detailed description of the invention when considered in conjunction  
10 with the accompanying drawings and claims.

#### BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 shows a first and second communication network  
15 within which the present invention can be applied.

Figure 2 illustrates an RRC Connection Establishment procedure in UTRAN.

20 Figure 3 illustrates the RRC Connection Release procedure in UTRAN.

#### DETAILED DESCRIPTION

25 According to a first aspect of the present invention the communication system 10 comprises means to inform user equipments 14 that are served by said system about the availability of UTRAN services. This network means is capable to inform the user equipment 14 about services, or  
30 at least a certain range of services, that are not available or inform it about available alternatives for the use of a certain requested service. It is then up to the user equipment, or the user, to select the appropriate network

when requesting for a new service. This can be realised by means of including such availability information in an appropriate information message that is sent within certain time periods, e.g. the system information that is updated periodically and sent to the user equipment 14. The information element transmitted in such a message should be such that all user equipments are requested to read this information when the system information is updated. This could be achieved by applying mechanisms that are currently specified in the Technical Specification document 3GPP TS25.331 "RRC Protocol Specifications" where a system information block is repeatedly sent on the BCCH with a certain periodicity. For instance, a system information block type 1, which currently contains core network related information, can also include indications about service availability. When the system information carrying the indications are updated a Paging type 1 message is sent to all user equipments in the cell with an information about the updated BCCH, which is also specified in said document 3GPP TS25.331. The user equipment 14 comprises the necessary means to perform a switch to the backup network 11 immediately if a service that is requested by the user equipment 14 is indicated to be unavailable. This method implies the advantage that the system information also covers all idle user equipments and user equipments on common channels. Alternatively, it would be possible to include availability information in a dedicated message, e.g. in the UTRAN mobility information, and send this information to the user equipments on dedicated channels whenever the information changes.

In a conceivable embodiment of the present invention, the user equipment comprises means to inform the user about the unavailable service, either immediately or as soon as the user takes any actions to request an unavailable service. By

that the user is also able to choose the appropriate priority level for a new requested service.

The following describes an example of the above mentioned functionality in said network 10 and said user equipment 14:

5 When assuming that the Iu-link towards a circuit-switched core network is interrupted, while the corresponding Iu-link towards the packet-switched core network works as usual, a user equipment 14 that is about to make, e.g., an emergency call is informed and can realise that the circuit-switched  
10 services are not available and instead set up a call over the backup network 11. Then, the same user equipment 14 when downloading packet data can continue to use the packet-switched core network part as usual on the original network or transfer also the packet-switched core network part to  
15 the backup network 11.

According to a second aspect of the present invention the network 10 is capable to re-direct a user equipment 14 to a backup network 11 in cases where a needed service in the UTRAN 10 is not available. The following describes thus an  
20 embodiment where the network arranges said re-direction autonomously with consideration of the assigned priority for said service where the user equipment is not involved in the decision for re-directing. There could be several reasons that services are not available: Link interruption, e.g. an  
25 Iu-link break, various congestion situations in the communication system, or resource shortages, e.g. for a call setup. This is true both when the user equipment 14 already applies a certain service that suddenly becomes unavailable or when the user equipment 14 requests for a new service.  
30 The user equipment can only apply services in one network at a time whereby the communication network 10 comprises the necessary means that enable the user equipment 14 to use those services that are still available in its present communication network 10 and re-direct the user equipment 14

to a backup network 11 if a requested service is not available but offered in said backup network 11.

In order to always be able to re-direct a user equipment 14 from UTRAN 10 to, e.g., a GSM-network 11, an information  
5 element (IE) denoting a re-direction retry indication must be included in the RRC Connection Setup Reject message, as provided for in the Technical Specification document 3GPP TS25.331, issued by the 3GPP, but at least the same parameters must also be included in the RRC Connection  
10 Release message. It is essential that this re-direction retry indication is included in said RRC Connection Release message as it is otherwise not possible to re-direct the user equipment 14, e.g., to said GSM-network 11 until said user equipment 14 makes a new access from its idle state.

15 This becomes apparent from the following example: If the user equipment 14 already has a connection towards a core network domain, a new request will be made with an already established RRC Connection instead of starting from the idle mode. When the original attempt fails, the user equipment 14  
20 still has the RRC-Connection, it will make a new attempt, which also fails, i.e. the user equipment 14 is locked in UTRAN 10 where the requested service is not available. Moreover, if the current connection is, e.g., towards the packet-switched core network and UTRAN 10 releases said user  
25 equipment 14 at, e.g., an incoming circuit-switched call (without a re-directed retry) it is very likely that the application in the user equipment 14 will connect again to the packet-switched Radio Access Bearer in the UTRAN before the user equipment has had the possibility to make a new  
30 attempt from its Idle mode towards the circuit-switched core network potentially through any existing backup network.

The following describes several examples of re-directions of user equipments 14 to a backup network 11:

1) A user equipment 14 has an ongoing emergency call when a Iu-link break towards the circuit-switched core network occurs. In this case, the call is to be released and re-directed to the backup network 11, e.g. the GSM-network. The  
5 UTRAN 10 releases the RRC connection by sending a RRC Connection Release message, as specified above, to the user equipment 14. The RRC Connection Release message includes the re-direct indication to, e.g., the GSM-network 11 so that the user equipment 14 does not retry to connect through  
10 UTRAN 10 again where the last connection failed.

2) A user equipment 14 having an ongoing communication over a packet-switched Radio Access Bearer when there is a Iu-link break towards the circuit-switched core network intends to apply a temporary unavailable service, e.g. to set up an  
15 emergency call. In this case, the user equipment 14 shall be released and re-directed to the backup network 11, e.g. the GSM-network. Also for this case, the UTRAN 10 releases the RRC connection with a RRC Connection Release message including an indication that the user equipment shall try,  
20 e.g., the GSM-network instead. Without this indication a normal RRC Connection release would lead to that the user equipment 14 appears to remain connected to the UTRAN 10 and will try to establish, e.g., currently unavailable service once more in this network. This is true especially since the  
25 ongoing packet-switched radio access bearer will try to re-establish the connection directly after the RRC connection release to the UTRAN, where the packet-switched services are available.

3) A user equipment 14 that wants to establish a packet  
30 Radio Access Bearer but fails due to a congestion shall have a possibility to be re-directed to a backup network 11, e.g. the GSM-network. For this purpose an appropriate information element (IE) denoting the re-direction retry indication is included in the RRC Connection Release message, said  
35 information element including at least the same parameters



as specified in the RRC Setup Reject message in order to re-direct the user equipment 14 to said backup network 11. If the packet-switched Radio Access Bearers are not available in the one network, the circuit-switched Radio Access Bearers can still be used in that network; however, if a user equipment wants to set up a packet connection it could be re-directed to the backup network that would provide the packet-switched Radio Access Bearers, e.g. in this case a GPRS-based network.

10 The present invention also allows shortening times within which a user equipment 14 is not pageable after a RRC Connection Release message and shortening of data interrupt times. This becomes apparent when assuming, e.g., that the UTRAN 10 releases a packet-switched connection, e.g. due to a congestion. Then, the data transfer interrupt time might be less if the user equipment 14 is directed to the backup network 11 after a RRC Connection Release message compared to the time during which the user equipment 14 could not transmit any data at all until the congestion in the original network 10 has been resolved. When assuming on the other hand that, e.g., the core network, or connections to it, do not work properly it would not be possible to page user equipments 14. In this case the time during which the user equipment 14 is not pageable can be significantly reduced by re-directing said user equipment 14 to the backup network 11 after a RRC Connection Release instead of waiting until the original network 10 works properly again.

When seen from the perspective of the user equipment, the present invention enables the user equipment 14 to inform the UTRAN 10 about the priority of requested services. In order for the UTRAN 10 to make the right decisions regarding whether a user equipment 14 should be re-directed to a backup network 11 or not it is important that the user has a possibility to inform the UTRAN 10 about the priority of a requested service and if current services should be released

to make sure that the new attempt will work. In order to cover service requests both for the idle user equipments and user equipments that already are connected, the indications for "priority" and "allow to release other services" are  
5 both included in the RRC Connection Request, the Initial Direct Transfer, the UL Direct Transfer, and the Cell Update.

This can be explained by help of an example: Assuming a user equipment having an ongoing Radio Access Bearer and  
10 requesting a new Radio Access Bearer. The reason why this request fails could be, e.g., a congestion in the transport network or that a service-server is not available. If the user can inform the UTRAN about the priority level of the requested Radio Access Bearer, e.g. a high priority, and  
15 that a release of other services is allowed, the UTRAN may release the user equipment using the RRC Connection Release with re-directed retry in order to be able to use the new requested service in a backup network, e.g. GSM or GPRS.